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SEMICONDUCTOR DEVICE	)

VERIFICATION OF TRANSLATION

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Sir:

I, Asami Maruyama, C/O Semiconductor Energy Laboratory Co., Ltd. 398, Hase, Atsugi-shi, Kanagawa-ken 243-0036 Japan, a translator, herewith declare:

that I am well acquainted with both the Japanese and English Languages;

that I am the translator of the attached English translation of the Japanese Patent Application No. 2004-017583 filed on January 26, 2004; and

that to the best of my knowledge and belief the following is a true and correct English translation of the Japanese Patent Application No. 2004-017583 filed on January 26, 2004.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: this 4th day of September, 2009

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[List of Attachment]

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[Name of Document] Scope of Claims

[Claim 1]

A method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a first conductive film pattern by discharging a conductive film material containing a photosensitive material over a substrate having an insulating surface by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light;

a step of forming a second conductive film pattern having a narrower width than that of the first conductive film pattern by developing the exposed first conductive film pattern;

a step of forming a gate insulating film covering the second conductive film pattern; and

a step of forming a semiconductor film over the gate insulating film.

[Claim 2]

A method for manufacturing a liquid crystal display device according to claim 1, characterized in that the conductive film material containing a photosensitive material comprises a compound or an elementary substance of Ag, Au, Cu, Ni, Al or Pt.

[Claim 3]

A method for manufacturing a liquid crystal display device according to claim 1 or claim 2, wherein the photosensitive material is a negative type photosensitive material.

[Claim 4]

A method for manufacturing a liquid crystal display device according to claim 1 or claim 2, wherein the photosensitive material is a positive type photosensitive material.

[Claim 5]

A method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of

substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a gate electrode over a surface of the first substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a positive type photosensitive material over the second semiconductor film by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by emitting selectively laser light from a surface side of the first substrate;

a step of forming a source electrode and a drain electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Claim 6]

A method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a gate electrode over a surface of the first substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a negative type photosensitive material over the second semiconductor film by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by emitting

laser light from a reverse surface side of the first substrate using the gate electrode as a mask;

a step of forming a source electrode and a drain electrode in a self-alignment manner to have a space that is the same as a width of the gate electrode by developing the exposed first conductive film pattern; and

a step of etching the first second semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Claim 7]

A liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, comprising:

a gate wiring or a gate electrode over the first substrate having an insulating surface;

a gate insulating film formed over the gate wiring or the gate electrode;

a semiconductor layer including a channel formation region over the gate insulating film;

a source electrode or a drain electrode formed over the semiconductor layer, and

a pixel electrode formed over the source electrode or the drain electrode,

characterized in that the channel formation region has a channel length that is the same as a width of the gate electrode and the gate electrode is the same as a space between the source electrode and the drain electrode.

[Claim 8]

A liquid crystal display device according to claim 7, characterized in that an active layer of the thin film transistor is a non single crystalline semiconductor film to which hydrogen or a hydrogen halide is added or a polycrystalline semiconductor film.

[Claim 9]

A liquid crystal display device according to claim 7 or claim 8, characterized in that the source electrode or the drain electrode contains a photosensitive material.

[Claim 10]

An electronic appliance, characterized in that the liquid crystal display device according to any one of claims 7 to 9 is an image-voice two-way communication device

or a versatile remote control device.

[Name of Document] Specification

[Title of Invention] ELECTRIC APPLIANCE, LIQUID CRYSTAL DISPLAY DEVICE, AND METHOD FOR MANUFACTURING THE SAME

[Technical Field]

[0001]

The present invention relates to a semiconductor device and a method for manufacturing the semiconductor device having a circuit composed of thin film transistors (hereinafter, TFT). More specifically, the present invention relates to an electric appliance installed with an electro-optic device as typified by a liquid crystal display panel as a component.

[0002]

Note that the semiconductor device in this specification refers to a device in general that can operate by utilizing semiconductor characteristics, and an electro-optic device, a semiconductor circuit, and an electric appliance are all semiconductor devices.

[Background Art]

[0003]

In recent years, technique of composing thin film transistors (TFT) by using a semiconductor thin film (with a thickness of approximately several to several hundreds nm) formed over a substrate having an insulating surface has attracted attention. A thin film transistor is widely applied to an electronic device such as an IC or an electro-optic device, and is especially rapidly developed as a switching element for an image display device.

[0004]

As an image display device, a liquid crystal display device is generally well known. An active matrix liquid crystal display device is used more often than a passive liquid crystal display device since a higher definition image is obtained. In an active matrix liquid crystal display device, a display pattern is formed on a screen by driving pixel electrodes arranged in a matrix configuration. Specifically, upon applying voltage between a selected pixel electrode and an opposing electrode corresponding to the pixel electrode, optical modulation of a liquid crystal layer interposed between the pixel electrode and the opposing electrode occurs, and the

optical modulation is recognized by a viewer as a display pattern.

[0005]

The range of application of such an active matrix electro-optic device is increased, and demands for higher definition, higher aperture ratio, and higher reliability have been increasing in accordance with increase of screen size.

[0006]

Conventionally, production technique of performing efficiently mass production by clipping a plurality of liquid crystal display panels from one mother glass substrate has been adopted. The mother glass substrate has grown in size from a first generation at the start of 1990, of 300×400 mm to a fourth generation in 2000, of 680 ×880 mm or 730×920 mm, and production technique has been progressed so that multiple display panels can be obtained from one substrate.

[0007]

In addition, simultaneously with increasing the screen size, requirements of improvement of productivity and reduction in costs have been increased.

[0008]

In addition, Patent Document 1 discloses technique for forming a film over a semiconductor wafer by using a device that can deliver continuously resist solution from a nozzle in the form of a line having a thin diameter to improve the yield of the liquid used for film formation.

[Patent Document 1] Unexamined patent publication No. 2000-188251

[Disclosure of the Invention]

[Problems to be solved by the Invention]

[0009]

In the present circumstances, a film formation method of using a spin coating method is heavily used in a manufacturing process. When the substrate size is further increased in a future, the film formation method of using a spin coating method becomes a disadvantage in mass production since a mechanism for rotating a large substrate becomes large and there is much loss of material solution and waste liquid. In addition, in the case that a rectangular substrate is spin coated, a coated film tends to have circular unevenness, with a rotation axis as a center. The present invention provides a manufacturing process using a droplet discharging method that is suitable for

a large substrate in mass production.

[0010]

In addition, the present invention provides a large screen display using a wiring formed by a droplet discharging method and the manufacturing method thereof. In addition, the present invention provides a liquid crystal display device in which a wiring is formed by a droplet discharging method to have a desired electrode width and a TFT having a channel length of 10 μm or less serves as a switching element.

[Means for solving the Problems]

[0011]

According to the present invention, a microscopic wiring pattern can be realized by discharging selectively photosensitive conductive film material solution by a droplet discharging method, exposing selectively to laser light or the like, and developing. The present invention can reduce drastically costs since a patterning process can be shortened and an amount of material which is used can be reduced in a process of forming a conductive pattern. Accordingly, the present invention can also be applied to a large substrate.

[0012]

The conductive film material solution contains a metal such as Ag, Au, Cu, Ni, Al, or Pt or an alloy; and photosensitive resin comprising organic high molecular resin, photo polymerization initiator, photo polymerization monomer, solvent, or the like. As the organic high molecular resin, novolac resin, acrylic based copolymer, methacrylic based copolymer, cellulose derivatives, cyclic rubber based resin, or the like can be used.

[0013]

A photosensitive material can be broadly divided into negative type and positive type. In the case of using the negative type photosensitive material, an exposed portion brings about chemical reactions, and the portion chemically reacted is only left due to developing solution, and then, a pattern is formed. In the case of using the positive type photosensitive material, an exposed portion brings about chemical reactions, and the portion chemically reacted is dissolved due to developing solution, then, unexposed portion is only left, and then, a pattern is formed.

[0014]

Further, since the wiring width is determined by accuracy of laser light irradiation, a desired wiring width can be obtained irrespective of an amount or viscosity of a drop or nozzle diameter. Generally, the wiring width is varied by a contact angle between material solution discharged from a nozzle and a substrate. For example, an amount discharged from a nozzle having a diameter (50 μm × 50 μm) of a typical ink jet device is 30 pl ~ 200 pl, and an obtained wiring width is 60 μm ~ 300 μm. A wiring having a narrow width (for example, an electrode width of 3 μm to 10 μm) can be obtained by laser light exposure according to the present invention. An amount discharged from a nozzle having a thinner diameter than that of a typical nozzle is 0.1 pl ~ 40 pl, and an obtained wiring width is 5 μm ~ 100 μm.

[0015]

In addition, in the case of forming a wiring pattern by a droplet discharging method, there are both the case where drops of a conductive material may be discharged intermittently from a nozzle in the form of a dot, and the case where the material may be discharged continuously from a nozzle and attached while being kept continuous in the form of a ribbon. In the present invention, a wiring pattern may be appropriately formed by any one of the above. In the case of forming a wiring pattern having a comparatively large width, the case that the material is attached while being kept continuous in the form of a ribbon by being discharged continuously from a nozzle leads to better productivity.

[0016]

Further, before forming a wiring pattern by a droplet discharging method, a base layer for improving adhesiveness is preferably formed (or base pretreatment is preferably performed) over a whole surface or a selected area of a substrate in advance. As formation of a base layer, treatment such that a photocatalyst substance (titanium oxide (TiO_X), strontium titanate ($SrTiO_3$), cadmium selenide (CdSe), potassium tantalate ($KTaO_3$), cadmium sulfide (CdS), zirconium oxide (ZrO_2), niobium oxide (Nb_2O_5), zinc oxide (ZnO), iron oxide (Fe_2O_3), or tungsten oxide (WO_3)) is dropped over the whole surface by a spraying method or a sputtering method may be performed. Alternatively, treatment such that an organic material (a coated insulating film using polyimide, acrylic, or a material which has a skeleton formed by the bond of silicon (Si) and oxygen (O), and which includes at least one of hydrogen, fluorine, an alkyl group,

and aromatic hydrocarbon as the substituent) is selectively formed by an ink jetting method or a sol-gel method may be performed.

[0017]

A photocatalyst substance refers to a substance having a photocatalyst function that yields photocatalyst activity by being irradiated with light in an ultraviolet region (wavelength of 400 nm or less, preferably, 380 nm or less). If a conductor mixed into solvent is discharged by a droplet discharging method as typified by an ink jetting method over a photocatalyst substance, a microscopic drawing can be realized.

[0018]

For example, before emitting light to TiO_X, TiO_X has a lipophilic property but no hydrophilic property, that is, the TiO_X is in a state having water-shedding quality. By light irradiation, TiO_X brings about photocatalyst activity and loses a lipophilic property but has a hydrophilic property. Further, TiO_X is capable of having both of a lipophilic property and a hydrophilic property depending on light irradiation time.

[0019]

Further, by adding a transition metal (Pd, Pt, Cr, Ni, V, Mn, Fe, Ce, Mo, W, and the like) into a photocatalyst substance by doping, photocatalyst activity can be improved or photocatalyst activity can be yielded due to light in a visible light region (wavelength of 400 nm ~ 800 nm). Since light wavelength can be determined by a photocatalyst substance as described above, light irradiation refers to emission of light of a wavelength that can yield photocatalyst activity of a photocatalyst substance.

[0020]

In addition, a conductor mixed into solvent can be discharged by a droplet discharging method as typified by an ink jetting method while light irradiation.

[0021]

In addition, after forming a photocatalyst substance that can bring about photocatalyst activity due to a wavelength of laser light over a whole surface, only an irradiated region can be modified by emitting selectively laser light to the photocatalyst substance. Further, a conductor mixed into solvent can be discharged by a droplet discharging method as typified by an ink jetting method while laser light irradiation.

[0022]

Note that a hydrophilic property refers to a property of being easier to be wet

by water. A super hydrophilic property refers to the state of having a contact angle of 30° or less, especially, 5 ° or less. On the other hand, a water-shedding property refers to a property of hardly being wet by water with a contact angle of 90° or more. Similarly, a lipophilic property refers to a state of being easier to be wet by oil, whereas an oil-shedding property refers to a state of hardly being wet by oil. Further, a contact angle means an angle formed by tangents of a drop to a formation surface at the edge of a dropped dot.

[0023]

In the case that conductive film material solution has a flow property or the flow property is increased in baking when forming a wiring by using conductive film material solution by a droplet discharging method, there is a threat that it becomes difficult to form a microscopic pattern due to dripping. Further, in the case that a space between wirings is narrow, there is a threat that patterns are in contact with each other. According to the present invention, a microscopic pattern can be obtained by mixing a photosensitive material into conductive film material solution to be precisely exposed to laser light and developed even if a wide pattern is formed by dripping.

[0024]

For example, in manufacturing a display performing large-area display, a bus line such as a gate wiring is preferably formed to be a wiring having a wide width formed by a droplet discharging method, whereas a gate electrode is preferably formed to be a wiring having a narrow width. In this instance, a gate wiring and a first gate electrode are formed by using conductive film material solution containing a positive photosensitive material, and laser light is selectively emitted to only a portion of the first gate electrode (portion one wishes to remove), then, the laser irradiated portion is developed, so that a second gate electrode processed into thin can be formed. In the case of forming the gate wiring and the first gate electrode by using conductive film material solution containing a negative photosensitive material, laser light is selectively emitted to only a portion of the gate wiring and the first gate electrode (portion one wishes to leave), and the laser irradiated portion is developed, so that a second gate electrode processed into thin can be formed.

[0025]

In addition, not only the gate electrode of a TFT, but also a source electrode, a

drain electrode, a pixel electrode, a capacitor wring, a lead wiring, and the like can be formed.

[0026]

In addition, depending on a wavelength of laser light, the light can pass through a glass substrate. The reverse surface of the glass substrate can be exposed to the laser light. By exposing the reverse surface of the glass substrate to light, a conductive film material at the periphery of an interface can be exposed to light in advance. Accordingly, adhesiveness between a wiring and a base layer, or adhesiveness between a wiring and a substrate can be improved.

[0027]

In addition, in the case of manufacturing a bottom gate TFT, a source electrode and a drain electrode can be formed in a self-aligning manner using a gate electrode as a mask by reverse surface exposure.

[0028]

The structure of the invention disclosed in this specification is a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, comprising:

a gate wiring or a gate electrode formed over the first substrate having an insulating surface;

a gate insulating film formed over the gate wiring or the gate electrode;

a semiconductor layer including a channel formation region over the gate insulating film;

a source electrode or a drain electrode formed over the semiconductor layer; and

a pixel electrode formed over the source electrode or the drain electrode;

characterized in that the channel formation region has a channel length that is the same as a width of the gate electrode and the gate electrode is the same as a space between the source electrode and the drain electrode.

[0029]

In addition, in the foregoing structure, an active layer of the TFT is a non single crystalline semiconductor film to which hydrogen or a hydrogen halide is added, or a

polycrystalline semiconductor film.

[0030]

In addition, the present invention can be applied regardless of the TFT structure. For example, a bottom gate (reverse staggered) TFT or a top gate (staggered) TFT can be used. Further, it is not limited to a single gate TFT, and a TFT may be formed to be a multigate TFT having a plurality of channel formation regions; such as a double gate TFT.

[0031]

Further, as an active layer of a TFT, an amorphous semiconductor film, a semiconductor film including a crystalline structure, a compound semiconductor film having an amorphous structure, and the like can be appropriately used. Furthermore, as the active layer of a TFT, the semiamorphous semiconductor film (also referred to as a microcrystalline semiconductor film or a microcrystal semiconductor film) that has an intermediate structure between an amorphous structure and a crystalline structure (including single crystals and poly crystals); a stable third state with respect to free energy; and a crystalline region having a short-range order and lattice distortion can be used.

[0032]

In addition, each of the foregoing structures is characterized in that the source electrode or the drain electrode contains a photosensitive material.

[0033]

In addition, in each of the foregoing structures, the liquid crystal display device is an image-voice two-way communication device or a versatile remote control device as illustrated in FIG. 19 (D) as an example.

[0034]

In addition, the structure of the invention related to a manufacturing method is a method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a first conductive film pattern by discharging a conductive film material containing a photosensitive material over a substrate having an insulating surface by a droplet discharging method;

a step of exposing the first conductive film pattern to laser light by selectively emitting the laser light;

a step of forming a second conductive film pattern having a narrower width than that of the first conductive film pattern by developing the exposed first conductive film pattern;

a step of forming a gate insulating film covering the second conductive film pattern; and

a step of forming a semiconductor film over the gate insulating film.

[0035]

In addition, the foregoing structure is characterized in that the conductive film material containing a photosensitive material contains a compound or an elementary substance of Ag, Au, Cu, Ni, Al, or Pt.

[0036]

In addition, the foregoing structure is characterized in that the photosensitive material is a negative type or positive type photosensitive material.

[0037]

In addition, another structure of the invention related to a manufacturing method is a method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a gate electrode over a surface of the first substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a positive type photosensitive material by a droplet discharging method over the second semiconductor film;

a step of exposing the first conductive film pattern to laser light by emitting selectively the laser light from a surface side of the first substrate;

a step of forming a source electrode and a drain electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[0038]

In addition, another structure of the invention related to a manufacturing method is a method for manufacturing a liquid crystal display device which is provided with a first substrate, a second substrate, and a liquid crystal held between a pair of substrates comprising the first substrate and the second substrate, characterized by comprising:

a step of forming a gate electrode over a surface of the first substrate having an insulating surface;

a step of forming a gate insulating film covering the gate electrode;

a step of forming a first semiconductor film over the gate insulating film;

a step of forming a second semiconductor film containing an impurity element imparting n-type or p-type conductivity over the first semiconductor film;

a step of forming a first conductive film pattern by discharging a conductive film material containing a negative type photosensitive material by a droplet discharging method over the second semiconductor film;

a step of exposing the first conductive film pattern to laser light by emitting laser light from a reverse surface side of the first substrate using the gate electrode as a mask;

a step of forming a source electrode and a drain electrode in a self-aligning manner to have a space which is the same as a width of the gate electrode by developing the exposed first conductive film pattern; and

a step of etching the first semiconductor film and the second semiconductor film using the source electrode and the drain electrode as masks.

[Effect of the Invention]

[0039]

A microscopic wiring pattern can be obtained by a droplet discharging method according to the present invention. In addition, the present invention can reduce drastically costs since a patterning process can be shortened and an amount of material

which is used can be reduced. Accordingly, the present invention can be applied to a large substrate.

[Best Mode for Carrying Out the Invention]

[0040]

Hereinafter, embodiments of the present invention are explained.

[0041]

(Embodiment 1)

Here, FIG. 1 and FIG. 2 illustrate an example for manufacturing an active matrix liquid crystal display device having a channel etch type TFT as a switching element.

[0042]

First, a base layer 11 for improving adhesiveness between a substrate 10 and a material layer that is formed later by a droplet discharging method is formed over the substrate 10. Since the base layer 11 may be formed to have an ultra thin thickness, the base layer is not always required to have a layered structure and considered as base pretreatment. Treatment such that a photocatalyst substance (titanium oxide (TiO_X), strontium titanate ($SrTiO_3$), cadmium selenide (CdSe), potassium tantalate ($KtaO_3$), cadmium sulfide (CdS), zirconium oxide (ZrO_2), niobium oxide (Nb_2O_5), zinc oxide (ZnO), iron oxide (Fe_2O_3), or tungsten oxide (WO_3)) is dropped over the whole surface by a spraying method or a sputtering method may be performed. Alternatively, treatment such that an organic material (a coated insulating film using polyimide, acrylic, or a material which has a skeleton formed by the bond of silicon (Si) and oxygen (O), and which includes at least one of hydrogen, fluoride, an alkyl group, and aromatic hydrocarbon as the substituent) is selectively formed by an ink jetting method or a sol-gel method may be performed.

[0043]

Here, an example in which base pretreatment for improving adhesiveness is performed in the case that a conductive material is discharged over the substrate is explained. However, the present invention is not particularly limited thereto. TiO_X depositing treatment may be performed to improve the adhesiveness between a material layer and another material layer in the case that a material layer (for example, an organic layer, an inorganic layer, or a metal layer) is formed by a droplet discharging method over another material layer (for example, an organic layer, an inorganic layer, or

a metal layer) or over a discharged conductive layer. That is, in the case that a conductive material is discharged to be drawn by a droplet discharging method, it is desired that base pretreatment is interposed at the interface between an upper conductive material layer and a lower conductive material layer to improve their adhesiveness.

[0044]

Further, as the base layer 11, not only a photocatalyst material, but also 3d transition metals (Sc, Ti, Cr, Ni, V, Mn, Fe, Co, Cu, Zn, or the like), oxides thereof, nitrides thereof, or oxynitrides thereof can be used.

[0045]

Note that, as the substrate 10, in addition to a non alkali glass substrate manufactured by a fusion method or a float method such as barium borosilicate glass, alumino borosilicate glass, or alumino silicate glass; a plastic substrate and the like having heat resistance that can resist a processing temperature of this manufacturing process can be used. In addition, in the case of manufacturing a reflective liquid crystal display device, a semiconductor substrate such as single crystal silicon, a metal substrate such as stainless steel, or a ceramic substrate with an insulating layer provided on the surface thereof may be used.

[0046]

Then, conductive film material solution is dropped by a droplet discharging method, typically, an ink jetting method to form a conductive film pattern 12 (FIG. 1 (A)). As a conductive material contained in the conductive film material solution, gold (Au), silver (Ag), copper (Cu), platinum (Pt), palladium (Pd), tungsten (W), nickel (Ni), tantalum (Ta), bismuth (Bi), lead (Pb), indium (In), tin (Sn), zinc (Zn), titanium (Ti), or aluminum (Al), alloys of the foregoing materials, dispersed nano particles of the foregoing materials, or silver halide fine particles can be used. Especially, a gate wiring preferably has low resistance. Accordingly, the gate wiring is preferably made from a material formed by solving or dispersing gold, silver, or copper into solvent in consideration of a specific resistance value. More preferably, silver or copper having low resistance is used. Further, in the case of using silver or copper, a barrier film is also provided to prevent impurities from dispersing. The solvent corresponds to esters such as butyl acetate, alcohols such as isopropyl alcohol, organic solvent such as

acetone, or the like. The surface tension and viscosity are appropriately adjusted by controlling the concentration of the solvent or by adding surface-active agent or the like.

[0047]

Here, FIG. 18 illustrates an example of a droplet discharging device.

[0048]

In FIG. 18, 1500 denotes a large substrate; 1504, an imaging means; 1507, a stage; 1511, a marker; and 1503, a region where one panel is formed. Heads 1505a, 1505b, and 1505c having the same widths as that of one panel are equipped for the droplet discharging device to scan the panel by moving the stage, e.g., in zigzags or back and forth, to form appropriately a pattern of a material layer. The heads can have the same widths as that of the large substrate; however, operation becomes easier by matching the heads' widths to that of one panel as illustrated in FIG. 18. Further, to improve throughput, a material is preferably discharged while keeping the stage moving.

[0049]

In addition, the heads 1505a, 1505b, and 1505c, and the stage 1507 have preferably temperature control functions.

[0050]

Note that the space between the head (tip of a nozzle) and the large substrate is approximately 1 mm. By narrowing the space, target accuracy can be improved.

[0051]

In FIG. 18, the heads 1505a, 1505b, and 1505c brought into three lines in the scan direction may be capable of forming different layers respectively, or discharging the same materials. In the case that an interlayer insulating film is pattern formed by discharging the same materials by the three heads, the throughput is improved.

[0052]

Note that the device illustrated in FIG. 18 can scan the substrate 1500 by securing the heads and moving the substrate 1500, and scan the substrate 1500 by securing the substrate 1500 and moving the heads.

[0053]

Each of the heads 1505a, 1505b, and 1505c of the droplet discharging means is connected to a controlling means. The heads can draw a pattern that is preliminarily

programmed by controlling the controlling means by a computer. The amount of discharging is controlled by an applied pulse voltage. The timing of the drawing, for example, may be based on the marker formed over the substrate. Alternatively, the base point may be decided on the basis of the edge of the substrate. The base point is detected by an imaging means such as CCD, converted into a digital signal by an image processing means, and recognized by a computer to generate a control signal. Then, the control signal is sent to the controlling means. Of course, information on a pattern that should be formed over a substrate is stored in a storing medium. The control signal can be sent based on this information to the controlling means to control each head of the droplet discharging means individually.

[0054]

Then, a part of the conductive film pattern is selectively irradiated with laser light to be exposed (FIG. 1 (B)). A photosensitive material is preliminarily contained in a conductive film material solution to be discharged to bring about a chemical reaction due to the laser light which is emitted. As the photosensitive material, an example of using a negative type photosensitive material leaving a portion that is reacted chemically by irradiation is described. By the laser light irradiation, a wiring having a precise pattern form, particularly, having a thin width can be obtained.

[0055]

Here, a laser beam drawing device is explained with reference to FIG. 4. A laser beam drawing device 401 comprises a personal computer (hereinafter, referred to as PC) 402 for executing various kinds of control in emitting a laser beam; a laser oscillator 403 for outputting a laser beam; a power source 404 of the laser oscillator 403; an optical system (ND filter) 405 for attenuating a laser beam; an acoustooptical modulator (AOM) 406 for modulating the intensity of a laser beam; a lens for enlarging and shrinking the cross-section of a laser beam; an optical system 407 composed of a mirror and the like for changing an optical path; a substrate moving mechanism 409 having an X stage and a Y stage; a D/A conversion portion 410 for digital-analog conversion of a control data outputted from the PC; a driver 411 for controlling the acoustooptical modulator 406 depending on analog voltage outputted from the D/A conversion portion; and a driver 412 for outputting a driving signal for driving the substrate moving mechanism 409.

[0056]

As the laser oscillator 403, the laser oscillator capable of oscillating ultraviolet light, visible light, or infrared light can be used. As the laser oscillator, an excimer laser oscillator such as KrF, ArF, KrF, XeCl, or Xe; a gas laser oscillator such as He, He-Cd, Ar, He-Ne, or HF; a solid laser oscillator using crystals such as YAG, $GdVO_4$, YVO_4, YLF, or $YalO_3$ doped with Cr, Nd, Er, Ho, Ce, Co, Ti, or Tm; or a semiconductor laser oscillator such as GaN, GaAs, GaAlAs, or InGaAsP can be used. Note that in the solid laser oscillator, a first harmonic to a fifth harmonic of a fundamental wave are preferably adopted.

[0057]

Hereinafter, a method for exposing a photosensitive material to light using a laser beam direct drawing device is explained. The photosensitive material as used herein means a conductive film material (including a photosensitive material) that is to be a conductive film pattern.

[0058]

When a substrate 408 is mounted on a substrate moving mechanism 409, the PC 402 detects the position of the marker attached to the substrate by a camera outside of the drawing. Then, the PC 402 produces movement data for moving the substrate moving mechanism 409 based on the position data of the marker that is detected and draw pattern data that is preliminarily inputted. And then, a laser beam outputted from the laser oscillator 403 is attenuated by the optical system 405, and the quantity of light is controlled to a predetermined quantity of light by the acoustooptical modulator 406 by means of the control of quantity of output light of the acoustooptical modulator 406 by the PC 402 via the driver 411. Meanwhile, a laser beam outputted from the acoustooptical modulator 406 is varied in its optical path and beam shape by the optical system 407, and condensed by a lens. Then, the beam is emitted to a photosensitive material formed over the substrate to expose the photosensitive material. At this time, movement control of the substrate moving mechanism 409 is performed in X direction and Y direction according to the movement data produced by the PC 402. As a result, a laser beam is emitted to a predetermined spot to expose a photosensitive material.

[0059]

A part of the energy of the laser light emitted to the photosensitive material is

converted into heat to react a part of the photosensitive material. Therefore, a width of a pattern becomes slightly larger than that of a laser beam. Further, since laser light of a short wavelength can make it easier for beam diameter to be converted small, a laser beam of a short wavelength is preferably emitted to form a pattern having an extremely thin width.

[0060]

In addition, the form of a laser beam spot on a surface of the photosensitive material is processed to have a point like shape, a round shape, an elliptical shape, a rectangular shape, or a line form (in a strict sense, an elongated oblong shape) by an optical system. The laser beam spot form may be a round shape. However, the laser beam spot form is preferably a line form, since the line form laser spot can form a pattern having a uniform width.

[0061]

An example of the device illustrated in FIG. 4 that exposes the substrate to laser light by emitting the laser light from the substrate surface side is described. However, a laser beam drawing device with an appropriately varied optical system or substrate moving mechanism that exposes the substrate to laser light by emitting the laser light from the reverse substrate surface side may be used.

[0062]

Here, a laser beam is selectively emitted while moving the substrate. However, the present invention is not limited thereto. A laser beam can be emitted while scanning the laser beam into X-Y axis direction. In this instance, a polygon mirror or a galvanometer mirror is preferably used as the optical system 407.

[0063]

Then, development is performed by using etchant (or developing solution) to remove excess portions, and main baking is performed to form a metal wiring 15 serving as a gate electrode or a gate wiring (FIG. 1 (C)).

[0064]

A wiring 40 extending to a terminal portion is formed as well as the metal wiring 15. Although not shown, a capacitor electrode or a capacitor wiring can be formed to form a storage capacitor if necessary.

[0065]

Note that, in the case that a positive photosensitive material is used, the portion to be removed may be irradiated with laser to yield a chemical reaction, and the portion may be dissolved by etchant.

[0066]

Alternatively, exposure by laser light irradiation may be performed after a conductive film material solution is dropped, dried at room temperature, and pre-baked.

[0067]

Then, a gate insulating film 18, a semiconductor film, and an n-type semiconductor film are sequentially deposited by a plasma CVD method or a sputtering method.

[0068]

As the gate insulating film 18, a material containing silicon oxide, silicon nitride, or silicon oxynitride as its main component obtained by a PCVD method is used. In addition, the gate insulating film 18 may be formed to be a SiOx film including an alkyl group by discharging by a droplet discharging method using siloxane based polymer and baking.

[0069]

The semiconductor film is formed with an amorphous semiconductor film or a semiamorphous semiconductor film formed by a vapor growth method, a sputtering method, or a thermal CVD method, each of which uses a semiconductor material gas as typified by silane or germane.

[0070]

As the amorphous semiconductor film, an amorphous silicon film that is obtained by a PCVD method using SiH_4 or a mixed gas of SiH_4 and H_2 can be used. In addition, as the semiamorphous semiconductor film, a semiamorphous silicon film that is obtained by a PCVD method using a mixed gas of SiH_4 diluted with H_2 by 3 to 1000 times, a mixed gas of Si_2H_6 and GeF_4 to have a gas flow ratio of 20 ~ 40: 0.9 (Si_2H_6: GeF_4), a mixed gas of Si_2H_6 and F_2 or a mixed gas of SiH_4 and F_2 can be used. Further, the semiamorphous silicon film is preferably used since the semiamorphous silicon film can hold more crystallinity at an interface between the semiamorphous silicon film and a base.

[0071]

In addition, the crystallinity may be further improved by laser light irradiation to the semiamorphous silicon film obtained by a PCVD method using a mixed gas of SiH_4 and F_2.

[0072]

An n-type semiconductor film can be formed with an amorphous semiconductor film or a semiamorphous semiconductor film by a PCVD method using a silane gas and a phosphine gas. Although an n-type semiconductor film 20 is preferably provided since the contact resistance between the semiconductor film and an electrode (formed in the subsequent process) becomes lower, the n-type semiconductor film 20 may be provided as-needed basis.

[0073]

Then, a mask 21 is provided to obtain an island-like semiconductor film 19 and the n-type semiconductor film 20 by etching selectively the semiconductor film and the n-type semiconductor film (FIG. 1 (D)). As a method for forming the mask 21, a droplet discharging method or a printing method (relief printing, surface printing, gravure printing, screen printing, or the like) is used. A desired mask pattern may be directly formed by a droplet discharging method or a printing method. Alternatively, a high definition microscopic resist pattern may be formed by forming sketchily a resist pattern by a droplet discharging method or a printing method, and by exposing selectively the resist pattern with use of laser light.

[0074]

By using a laser beam drawing device illustrated in FIG. 4, resist can be exposed to light. In this instance, the resist mask 21 may be formed by exposing a photosensitive material used as resist to laser light.

[0075]

Then, after removing the mask 21, source or drain wirings 22, 23 are formed by discharging selectively a composite containing a conductive material (Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like) by a droplet discharging method. Similarly, a connecting wiring (not shown) is formed at a terminal portion (FIG. 1 (E)).

[0076]

Then, the n-type semiconductor film and an upper layer portion of the

semiconductor film are etched using the source or drain wirings 22, 23 as masks to obtain the state illustrated in FIG. 2 (A). At this stage, a channel etch TFT having a channel formation region 24 which serves as an active layer, a source region 26, and a drain region 25, is completed.

[0077]

In addition, a protective film 27 to prevent the channel formation region 24 from being contaminated by impurities is formed (FIG. 2 (B)). As the protective film 27, a material containing silicon nitride or silicon nitride oxide as its main component formed by a sputtering method or a PCVD method is used. In this instance, an example of using the protective film is described, however, the protective film is not necessarily provided if not needed.

[0078]

Then, an interlayer insulating film 28 is selectively formed by a droplet discharging method. As the interlayer insulating film 28, a resin material such as epoxy resin, acrylic resin, phenol resin, novolac resin, acryl resin, melamine resin, or urethane resin is used. In addition, an organic material such as benzocyclobutene, parylene, flare, or polyimide having permeability; a compound material formed by polymerization of siloxane polymer and the like; a composite material containing water-soluble homopolymer and water-soluble copolymer; or the like is formed by a droplet discharging method. A method for forming the interlayer insulating film 28 is not particularly limited to the droplet discharging method. A coating method, a PCVD method, or the like can be used to form the interlayer insulating film 28 over a whole surface.

[0079]

Then, the protective film is etched using the interlayer insulating film 28 as a mask to form a convex portion (pillar) 29 made from a conductive member over a part of the source or drain wiring 22, 23. The convex portion (pillar) 29 may be stacked by repeating discharging and baking of a composite containing a conductive material (Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like). Further, after etching the protective film, etching is further performed at a terminal portion using the interlayer insulating film as a mask, so that the gate insulating film is also removed selectively.

[0080]

And then, a pixel electrode 30 being in contact with the convex portion (pillar) 29 is formed over the interlayer insulating film 28 (FIG. 2 (C)). Note that, similarly, a terminal electrode 41 being in contact with the wiring 40 is also formed. In the case of manufacturing a transmissive liquid crystal display panel, the pixel electrode 30 and the terminal electrode 41 are formed by forming a predetermined pattern made from a composite containing indium tin oxide (ITO), indium tin oxide containing silicon oxide (ITSO), zinc oxide (ZnO), tin oxide (SnO_2), or the like by a droplet discharging method or a printing method to be baked. Then, in the case of manufacturing a reflective liquid crystal display panel, the pixel electrode 30 and the terminal electrode 41 can be formed with a composite made from metal particles as its main component, such as Ag (silver), Au (gold), Cu (copper), W (tungsten), or Al (aluminum), by a droplet discharging method. As another method, the pixel electrode may be formed by forming a transparent conductive film or a light-reflective conductive film by a sputtering method, and forming a mask pattern by a droplet discharging method, then, combining etching therewith.

[0081]

FIG. 3 illustrates an example of a top view of a pixel at the stage illustrated in FIG. 2 (C). A cross-section taken along chain line of A-A' in FIG. 3 corresponds to a cross-sectional view in FIG. 2 (C). Note that corresponding components are denoted by like numerals.

[0082]

According to the foregoing processes, a TFT substrate used for a liquid crystal display panel in which a bottom gate (also referred to as reverse staggered) TFT and a pixel electrode are formed over the substrate 10 is completed.

[0083]

Then, an orientation film 34a is formed to cover the pixel electrode 30. Note that the orientation film 34a may be formed by a droplet discharging method, a screen printing method, or an offset printing method. Thereafter, rubbing treatment of the surface of the orientation film 34a is performed.

[0084]

Then, a color filter composed of a coloring layer 36a, a light-shielding layer

(black matrix) 36b, and an overcoat layer 37 is provided over an opposing substrate 35; an opposing electrode formed using a transparent electrode is further formed; and an orientation film 34b is formed thereover. Then, sealant forming a closed pattern (not shown) is formed to surround a region that is overlapped with a pixel portion by a droplet discharging method. Although an example of drawing sealant forming a closed pattern is described since liquid crystals are dropped here, alternatively, a seal pattern provided with an opening portion may be provided and a dipping mode (upwelling mode) in which liquid crystals are injected due to capillary phenomenon after pasting the TFT substrate may be used. In addition, the color filter can also be formed by a droplet discharging method.

[0085]

Then, a liquid crystal is dropped to paste both the substrates to each other under reduced pressure in order that bubbles do not enter. The liquid crystal is dropped within the closed-loop seal pattern once or a plurality of numbers of times. As an orientation mode of the liquid crystal, a TN mode in which the arrangement of liquid crystal molecules is twist-oriented at 90° in the direction of from incident light to outgoing light, is often adopted. In the case of manufacturing a TN mode liquid crystal display device, substrates are pasted to each other so that rubbing directions of the substrates are at right angles to each other.

[0086]

Note that a pair of the substrates may be spaced by dispersing spherical spacers, forming a column-like spacer made from resin, or making filer contained into sealant. The foregoing column-like spacer is an organic resin material containing at least any one of acrylic, polyimide, polyimide amide, and epoxy as its main component; a material which is any one kind of silicon oxide, silicon nitride, and silicon oxynitride; or an inorganic material formed by a laminated film made from the foregoing materials.

[0087]

Then, an unnecessary substrate is trimmed. In the case of forming multiple panels from one substrate, trimming is performed for each panel. In the case of forming one panel from one substrate, the trimming process can be omitted by pasting a preliminarily divided opposing substrate onto the substrate.

[0088]

Then, an FPC 46 is pasted via an anisotropic conductive layer 45 by known technique. A liquid crystal module is completed according to the foregoing processes (FIG. 2 (D)). Further, an optical film is pasted if necessary. In the case of manufacturing a transmissive liquid crystal display device, a polarized plate is pasted onto both an active matrix substrate and an opposing substrate.

[0089]

As mentioned above, in this embodiment, a microscopic pattern can be realized by exposing the conductive film pattern using a droplet discharging method to laser light and by developing. In addition, by forming various patterns directly over the substrate by a droplet discharging method, a liquid crystal display panel can be readily manufactured even if a fifth generation and later glass substrate having a side of over 1000 mm is used.

[0090]

In addition, this embodiment explains a process that does not perform spin coating and that does not perform a light exposure process using a photo mask as much as possible. However, the present invention is not particularly limited thereto, and a part of the patterning can be performed by a light exposure process using a photo mask.

[0091]

(Embodiment 2)

In Embodiment 1, an example of exposing a gate wiring by a laser beam drawing device is described. In this embodiment, a process example of using a laser beam drawing device for forming a source wiring or a drain wiring is explained with reference to FIG. 5.

[0092]

Note that the process differs only partially from that explained Embodiment 1, and so the description for the same process will be omitted for simplification.

[0093]

First, similarly to Embodiment 1, a process up to a patterning process of a semiconductor film is performed. Then, a conductive film pattern 220 is formed by a droplet discharging method (FIG. 5 (A)). A positive type photosensitive material is contained into the conductive film pattern 220.

[0094]

Then, the conductive film pattern 220 is exposed to laser light selectively by using the device illustrated in FIG. 4 (FIG. 5 (B)). A portion 221 that is irradiated with the laser light brings about chemical reactions.

[0095]

Then, the portion 221 that is irradiated with laser light is removed by developing to form source or drain wirings 222, 223 (FIG. 5 (C)).

[0096]

Since the space between the source or drain wirings 222, 223 formed in this manner is determined by laser light irradiation, a practitioner can freely set the space. Setting freely the space between the source or drain wirings 222, 223 is useful since the space determines the length (L) of a channel formation region.

[0097]

Next, the state illustrated in FIG. 5 (D) is obtained by etching an n-type semiconductor film and an upper layer portion of the semiconductor film using the source or drain wiring 222, 223 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 224 that serves as an active layer, a source region 226, and a drain region 225, is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description will be omitted.

[0098]

In the case of forming the source wiring or the drain wiring by using a droplet discharging method, the space therebetween should be secured to some extent in consideration of a margin for dripping or the like. Therefore, the length (L) of the channel formation region was difficult to be reduced. When exposure can be performed using the laser light as explained in this embodiment, the length (L) of the channel formation region can be shortened, for example, 10 μm or less.

[0099]

In addition, this embodiment can be freely combined with Embodiment 1.

[0100]

(Embodiment 3)

In addition, FIG. 6 illustrates an example of other process. In FIG. 6, an example of using a planarizing film as a gate insulating film 260 is illustrated. Other portions are the same as those explained in Embodiment 2.

[0101]

Here, after forming a gate electrode, the gate insulating film 260 having a plane surface is formed by a sputtering method, a planarizing treatment of a film obtained by a CVD method, or a coating method. Note that the planarizing treatment is typified by CMP treatment or the like.

[0102]

In the case of manufacturing a liquid crystal display device having a large area screen, a gate wiring having low resistance may be preferably formed to have a thick thickness, for example, of 1 μm ~ 5 μm. When a cross-sectional area is increased by increasing the thickness of a wiring, difference in level between the surface of the substrate and the surface of the thick film wiring is produced, which leads to deterioration of liquid crystal orientation. The plane gate insulating film 260 is useful in the case of increasing the thickness of the gate wiring as described above.

[0103]

Generally, the substrate surface provided with a metal wiring has a structure with a protrusion by the thickness of the metal wiring. In this embodiment, the substrate surface is plane because of the plane gate insulating film 260. Accordingly, coverage deterioration or the like hardly occurs even if the thickness of a semiconductor film is reduced.

[0104]

Then, similarly to Embodiment 1, a semiconductor film and an n-type semiconductor film are sequentially formed. Then, a mask is provided to etch selectively the semiconductor film and the n-type semiconductor film. Accordingly, island like semiconductor film and n-type semiconductor film can be obtained.

[0105]

Then, similarly to Embodiment 2, a conductive film pattern 250 is formed by a droplet discharging method (FIG. 6 (A)).

[0106]

Then, the conductive film pattern 250 is selectively exposed to laser light by using the device illustrated in FIG. 4 (FIG. 6 (B)).

[0107]

Then, a portion 251 that is irradiated with laser light is removed by developing

to form source or drain wirings 252, 253 (FIG. 6 (C)).

[0108]

Next, the state illustrated in FIG. 6 (D) is obtained by etching the n-type semiconductor film and an upper layer portion of the semiconductor film using the source or [0109]drain wirings 252,253 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 254 that serves as an active layer, a source region 256, and a drain region 255 is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description thereof will be omitted.

[0109]

In addition, this embodiment can be freely combined with Embodiment 1 or Embodiment 2.

[0110]

(Embodiment 4)

FIG. 7 illustrates an example of a process of forming a source wiring or a drain wiring using a gate electrode as a mask in a self-aligning manner by light exposure of a reverse-surface.

[0111]

First, a base insulating film 301 is formed over a substrate. As the base insulating film 301, a base film formed with an insulating film such as a silicon oxide film, a silicon nitride film, or a silicon oxynitride film is formed. Note that the base insulating film may not be formed when it is not required.

[0112]

Then, a conductive film having a thickness of 100 ~ 600 nm is formed by a sputtering method over the base insulating film 301. Note that the conductive film may be formed of an element selected from Ta, W, Ti, Mo, Al, and Cu; a single layer made from an alloy material or a compound material containing the foregoing elements as its main component, or a laminated layer of the foregoing single layers. Alternatively, a semiconductor film as typified by a polycrystalline silicon film doped with an impurity element such as phosphorus may be used.

[0113]

Then, a resist mask is formed by using a photo mask and etching is performed

by a dry etching method or a wet etching method. The conductive film is etched by the etching process to obtain a gate electrode 302 as illustrated in FIG. 7 (A).

[0114]

Next, similarly to Embodiment 1, a gate insulating film, a semiconductor film, and an n-type semiconductor film are sequentially deposited by a plasma CVD method or a sputtering method. Then, a mask is provided to selectively etch the semiconductor film and the n-type semiconductor film. Accordingly, island like semiconductor film and n-type semiconductor film are obtained.

[0115]

Then, similarly to Embodiment 2, a conductive film pattern 320 is formed by a droplet discharging method (FIG. 7 (A)). A negative type photosensitive material is contained into the conductive film pattern 320.

[0116]

Then, the reverse surface is exposed to laser light in a self-aligning manner by using a laser beam drawing device (FIG. 7 (B)). The portion irradiated with laser light in the conductive film pattern brings about chemical reactions. Note that a substrate that has a light transmitting property is used as the substrate. Laser light having a wavelength that passes through the substrate is selected.

[0117]

And then, developing is performed, and a portion that is not irradiated with the laser light is removed to form source or drain wirings 322, 323 (FIG. 7 (C)).

[0118]

The space between the source or drain wirings 322, 323 formed as described above is determined by the width of the gate electrode.

[0119]

Then, the state illustrated in FIG. 7 (D) is obtained by etching the n-type semiconductor film and an upper layer portion of the semiconductor film using the source or drain wirings 322, 323 as masks. At this state, a channel etch TFT, which is provided with a channel formation region 324 that serves as an active layer, a source region 326, and a drain region 325 is completed. The subsequent processes are the same as that explained in Embodiment 1, and the detailed description thereof will be omitted.

[0120]

Since a channel formation region of a TFT is formed in a self-aligning manner according to the present invention, patterning difference is not produced and variation of each TFT can be reduced. According to the present invention, a manufacturing process can be simplified.

[0121]

In addition, this embodiment can be freely combined with Embodiment 1, Embodiment 2, or Embodiment 3.

[0122]

(Embodiment 5)

A method for manufacturing an active matrix liquid crystal display device having a channel stop TFT as a switching element is explained in this embodiment.

[0123]

In addition, as illustrated in FIG. 8, a base film 811 is formed over a substrate 810 as in the case of Embodiment 1 as described above. As the base film 811, TiO_2 that is a photocatalyst substance is entirely formed.

[0124]

Then, light having a wavelength that causes photocatalyst action is emitted to the desired region, that is, TiO_2 at the both edges of a region provided with a wiring in this embodiment, and an irradiated region is formed. Laser light can be used as the light having a wavelength that causes photocatalyst action. The light is selectively emitted to a desired region by using the device illustrated in FIG. 4. Accordingly, the irradiated region exhibits an oil-shedding property.

[0125]

A conductive film serving as a gate electrode 815 is formed by dropping a dot formed by mixing a conductor into solvent from an upper portion of a non irradiated region or to a non irradiated region by an ink jetting method. Simultaneously, a terminal electrode 840 is formed at a terminal portion.

[0126]

Then, a gate insulating film 818 is formed to cover the gate electrode. Thereafter, a semiconductor film is formed by plasma CVD or the like. And then, in order to form a channel protective film 827, an insulating film is formed by, for example,

a plasma CVD method to be patterned at a desired region to have a desired form. In this instance, the channel protective film 827 can be formed by exposing the reverse surface of the substrate to light using the gate electrode as a mask. Further, the channel protective film may be formed by dropping polyimide, polyvinyl alcohol, or the like by an ink jetting method. As a result, an exposure process can be eliminated.

[0127]

Thereafter, a semiconductor film having one conductivity type, for example, an n-type semiconductor film is formed by a plasma CVD method or the like.

[0128]

Then, a mask made from polyimide is formed by an ink jetting method over the n-type semiconductor film. A semiconductor film 824 and the semiconductor film having n-type conductivity are patterned by using the mask. Thereafter, cleaning is performed to remove the mask.

[0129]

Next, wirings 823, 822 are formed. Then, the wirings 823, 822 can be formed by an ink jetting method. The wirings 823, 822 serve as so-called a source wiring or a drain wiring.

[0130]

Then, an interlayer insulating film 828 is formed. Then, a contact hole reaching the wiring 824 is formed in the interlayer insulating film. An electrode 830 is formed in the contact hole.

[0131]

Then, an electrode 829 connecting electrically to the wiring 824 via the electrode 830 is formed. Simultaneously, an electrode 841 is formed at the terminal portion. The electrodes 829, 841 can be formed by an ink jetting method. The electrode 829 serves as a pixel electrode in a liquid crystal display device. As the electrode 829, a dot formed by mixing a conductor into water type solvent can be used. In particular, a transparent conductive film can be formed by using especially a transparent conductor.

[0132]

At this stage, a TFT substrate for a liquid crystal display panel as illustrated in FIG. 8 provided with a channel stop TFT and a pixel electrode is completed. The

subsequent processes are the same as those explained in Embodiment 1, and the detailed description thereof will be omitted.

[0133]

In this embodiment, the wiring or the electrode that can be obtained by an ink jetting method can also be formed, as explained in Embodiment 1, by discharging a conductive film material solution containing a photosensitive material to be exposed to laser light. Further, the resist mask can also be formed by exposure to laser light.

[0134]

In addition, this embodiment can be freely combined with any one of Embodiments 1 to 4.

[0135]

(Embodiment 6)

In this embodiment, a method for manufacturing an active matrix liquid crystal display device having a staggered TFT that is manufactured by a droplet discharging method as a switching element is explained.

[0136]

First, a base film 911 for improving adhesiveness with a material layer that is formed later by a droplet discharging method is formed over a substrate 910.

[0137]

Next, a source wiring layer and a drain wiring layer 923, 924 are formed by a droplet discharging method over the base film 911.

[0138]

In addition, a terminal electrode 940 is formed at a terminal portion. As a conductive material for forming the foregoing layers, a composite made from metal particles as its main component, such as Ag (silver), Au (gold), Cu (copper), W (tungsten), or Al (aluminum), can be used. Since the source and drain wiring layers are preferably reduced in its resistance, any one of materials of gold, silver, and copper dissolved or dispersed into solvent is preferably used in consideration of specific resistance value. More preferably, silver or copper having low resistance is used. As the solvent, esters such as butyl acetate, alcohols such as isopropyl alcohol, organic solvent such as acetone, or the like can be used. The surface tension and the viscosity are appropriately controlled by adjusting the concentration of the solvent or adding

surface-active agent or the like.

[0139]

Then, after an n-type semiconductor layer is formed over a whole surface, the n-type semiconductor layer between the source wiring layer and the drain wiring layer 923, 924 is removed by etching.

[0140]

Next, a semiconductor film is formed over a whole surface. The semiconductor film is formed with an amorphous semiconductor film or a semiamorphous semiconductor film formed by a vapor growth method or a sputtering method using a semiconductor material gas as typified by silane or germane.

[0141]

Then, a mask is formed by a droplet discharging method. Then, the semiconductor film and the n-type semiconductor layer are patterned to form a semiconductor layer 927 and n-type semiconductor layers 925, 926 as illustrated in FIG. 9. The semiconductor layer 927 is formed to extend over both the source wiring layer and the drain wiring layer 923, 924. The n-type semiconductor layers 925, 926 are interposed between the source wiring layer and the drain wiring layer 923, 924, and the semiconductor layer 927.

[0142]

Then, a gate insulating film is formed with a single layer or a laminated layer structure by a plasma CVD method or a sputtering method. As the most preferable mode, the gate insulating film is formed by using a stack of three layers; that is, an insulating layer made from silicon nitride, an insulting layer made from silicon oxide, and an insulating layer made from silicon nitride.

[0143]

Next, a mask is formed by a droplet discharging method to pattern the gate insulating layer 918.

[0144]

Then, a gate wiring 915 is formed by a droplet discharging method. As a conductive material for forming the gate wiring 915, a composite containing metal particles of Ag (silver), Au (gold), Cu (copper), W (tungsten), Al (aluminum), or the like as its main component can be used. The gate wiring 915 is extended to the terminal

portion to be in contact with the terminal electrode 940 of the corresponding terminal portion.

[0145]

Then, a plane interlayer insulating film 928 is formed by a coating method. In addition, the interlayer insulating film is not limited to be formed by a coating method and can be formed by using an inorganic insulating film such as a silicon oxide film formed by a vapor growth method or a sputtering method. Alternatively, a silicon nitride film may be formed by a PCVD method or a sputtering method as a protective film, and then a plane insulating film may be stacked by a coating method.

[0146]

Then, a contact hole reaching the drain wiring 924 is formed in the interlayer insulating film. An electrode 930 is formed in the contact hole.

[0147]

Then, an electrode 929 connecting electrically to the wiring 924 via the electrode 930 is formed. Simultaneously, an electrode 941 is formed at the terminal portion. The electrodes 929, 941 can be formed by an ink jetting method. The electrode 929 serves as a pixel electrode of a liquid crystal display device. As the electrode 929, a dot formed by mixing a conductor into water type solvent can be used. A transparent conductive film can be formed by using especially a transparent conductor.

[0148]

At this stage, a TFT substrate for a liquid crystal display panel as illustrated in FIG. 9 provided with a top gate (staggered) TFT and a pixel electrode is completed. The subsequent processes are the same as those explained in Embodiment 1, and the detailed description thereof will be omitted.

[0149]

In this embodiment, the wiring or the electrode that is obtained by an ink jetting method can also be formed, as explained in Embodiment 1, by discharging a conductive film material solution containing a photosensitive material to be exposed to laser light. Further, the resist mask can also be formed by exposure to laser light.

[0150]

In addition, this embodiment can be freely combined with any one of

Embodiments 1 to 4.

[0151]

The present invention composed of the foregoing aspects is described in more detail using the following examples.

[0152]

(Example 1)

In this example, an example of using a droplet discharging method for dropping liquid crystals is described. In this example, FIG. 10 illustrates a manufacturing example for taking four panels using one large substrate.

[0153]

FIG. 10 (A) is a cross-sectional view during formation of a liquid crystal layer by dispenser (or ink jetting). A liquid crystal material 1114 is discharged, sprayed, or dropped from a nozzle 1118 of a liquid crystal discharging device 1116 so as to cover a pixel portion 1111 surrounded by sealant 1112. The liquid crystal discharging device 1116 is moved in the direction indicated by arrow in FIG. 10 (A). Further, an example of moving the nozzle 1118 is explained here, however, the nozzle may be secured and the substrate may be moved to form the liquid crystal layer.

[0154]

In addition, FIG. 10 (B) is a perspective view and illustrates that the liquid crystal material 1114 is selectively discharged, sprayed, or dropped only to the region surrounded by the sealant 1112; and a drop surface 1115 is moved along with a nozzle scanning direction 1113.

[0155]

In addition, FIG. 10 (C) and FIG. 10 (D) are enlarged cross-sectional views of a portion 1119 encircled by a dotted line illustrated in FIG. 10 (A). In the case that the liquid crystal material has high viscosity, the liquid crystal material is discharged continuously and adhered while being continuous as illustrated in FIG. 10 (C). On the other hand, in the case that the liquid crystal material has low viscosity, the liquid crystal material is discharged intermittently, that is, droplets are dropped as shown in FIG. 10 (D).

[0156]

Note that in FIG. 10 (C), 1120 denote a reverse staggered TFT obtained

according to Embodiment 1, and 1121 denotes a pixel electrode, respectively. The pixel portion 1111 is composed of pixel electrodes arranged in a matrix configuration, a switching element connected to the pixel electrode, the reverse staggered TFT that is used in this instance, and a storage capacitor (not shown).

[0157]

Here, a manufacturing flow of a panel is hereinafter explained with reference to FIG. 11 (A) to FIG. 11 (D).

[0158]

First, a first substrate 1035 provided with a pixel portion 1034 over the insulating surface is prepared. As for the first substrate 1035, preliminarily, an orientation film is formed, rubbing treatment is performed, a spherical spacer is dispersed or a columnar spacer is formed, or a color filter is formed, or the like . Then, as illustrated in FIG. 11 (A), sealant 1032 is formed at the predetermined position (pattern surrounding the pixel portion 1034) over the first substrate 1035 in an inert gas atmosphere or under reduced pressure by a dispenser device or an ink jet device. As the semitransparent sealant 1032, a material including filler (diameter of from 6 μm ~ 24 μm) and having viscosity of 40 ~ 400 Pa·s is used. Further, the sealant that is not dissolved in liquid crystal that is to be in contact with the sealant is preferably selected. As the sealant, acrylic based photo curing rein or acrylic based heat curing resin may be used. The sealant 1032 can be formed by a printing method since it is a simple seal pattern.

[0159]

Then, a liquid crystal 1033 is dropped by an ink jetting method in the region surrounded by the sealant 1032 (FIG. 11 (B)). As the liquid crystal 1033, a known liquid crystal material that has viscosity capable of being discharged by an ink jetting method may be used. Since the viscosity of a liquid crystal material can be set by controlling temperature, a liquid crystal material is suitable for an ink jetting method. By an ink jetting method, a necessary amount of the liquid crystal 1033 can be held without waste in the region surrounded by the sealant 1032.

[0160]

Then, the first substrate 1035 provided with the pixel portion 1034 is pasted onto the second substrate 1031 provided with the opposing electrode or the orientation

film under reduced pressure so that air bubbles do not enter (FIG. 11 (C)). In this instance, the sealant 1032 is cured by ultraviolet irradiation or heat treatment simultaneously with the pasting. Note that, in addition to the ultraviolet irradiation, heat treatment can also be performed.

[0161]

In addition, FIG. 12 illustrates an example of a pasting device capable of performing UV irradiation or heat treatment in pasting or after pasting.

[0162]

In FIG. 12, 1041 denotes a first substrate support medium; 1042, a second substrate support medium; 1044, a window; 1048, a lower surface table; and 1049, a light source. Note that in FIG. 12, corresponding components in FIG. 11 are denoted by like numerals.

[0163]

The lower surface table 1048 is installed with a heater for curing sealant. In addition, the second substrate support medium is provided with the window 1044 to pass ultraviolet light from the light source 1049. Although not shown here, position alignment of a substrate is performed through the window 1044. Further, the second substrate 1031 serving as an opposing substrate is preliminarily cut into a desired size and secured to the medium 1042 by a vacuum chuck or the like. FIG. 12 (A) illustrates the state before pasting.

[0164]

In pasting, the first substrate support medium and the second substrate support medium are moved down, and the first substrates 1035 and the second substrate 1031 are pasted together with pressure, then, ultraviolet light is emitted to the pasted substrates to be cured. FIG. 12 (B) illustrates the state after pasting.

[0165]

Then, the first substrate 1035 is cut by using a cutting device such as a scriber device, a breaker device, a roll cutter, or the like (FIG. 11 (D)). Accordingly, four panels are manufactured from one substrate. Then, an FPC is pasted by known technique.

[0166]

Note that, as the first substrate 1035 and the second substrate 1031, a glass

substrate or a plastic substrate can be used.

[0167]

FIG. 13 (A) illustrates a top view of a liquid crystal module obtained according to the foregoing processes. FIG. 13 (B) illustrates an example of a top view of another liquid crystal module.

[0168]

In FIG. 13 (A), 1201 denotes an active matrix substrate; 1206, an opposing substrate; 1204, a pixel portion; 1207, sealant; and 1205, an FPC. Further, a liquid crystal is discharged by a droplet discharging method and the pair of substrates 1201, 1206 are pasted by the sealant 1207 under reduced pressure.

[0169]

In the case that a TFT having an active layer made from a semiamorphous silicon film is used, a part of a driver circuit can also be manufactured and a liquid crystal module as illustrated in FIG. 13 (B) can be manufactured.

[0170]

FIG. 15 is a block diagram of a scanning line driver circuit composed of an n-channel TFT using SAS (semiamorphous silicon) from which electric field effect mobility of 5 ~ 50 $cm^2/Vsec$ can be obtained.

[0171]

In FIG. 15, a block denoted by 500 corresponds to a pulse output circuit that outputs one stage of a sampling pulse. A shift resister is composed of n numbers of pulse output circuits. 501 denotes a buffer circuit. A pixel 502 is connected to the tip of the buffer circuit.

[0172]

FIG. 16 illustrates a specific configuration of the pulse output circuit 500, which is composed of n-channel TFTs 601 to 612. At this time, the sizes of the TFTs may be determined in consideration of operating characteristics of the n-channel TFTs using SAS. For example, if the channel length is 8 μm, the channel width can be set in the range of 10 ~ 80 μm.

[0173]

In addition, FIG. 17 illustrates a specific configuration of the buffer circuit 501. The buffer circuit is also composed of n-channel TFTs 620 to 635. At this time, the

sizes of the TFTs may be determined in consideration of operating characteristics of the n-channel TFTs using SAS. For example, if the channel length is 10 μm, the channel width can be set in the range of 10 ~ 1800 μm.

[0174]

Note that a driver circuit that cannot be formed by a TFT having an active layer formed by using a semiamorphous silicon film is mounted with an IC chip (not shown).

[0175]

In FIG. 13 (B), 1211 denotes an active matrix substrate; 1216, an opposing substrate; 1212, a source signal line driver circuit; 1213, a gate signal line driver circuit; 1214, a pixel portion; 1217, first sealant; and 1215, an FPC. Further, a liquid crystal is discharged by a droplet discharging method and the pair of substrates 1211, 1216 are pasted by the first sealant 2517 and second sealant. The driver circuit portions 1212, 1213 do not require a liquid crystal, and so a liquid crystal is provided in only the pixel portion 1214. The second sealant 1218 is provided to reinforce the whole of the panel.

[0176]

In addition, the obtained liquid crystal module is provided with a back light valve 1304 and a mirror, and covered by a cover 1306. Accordingly, an active matrix liquid crystal display device (transmissive type) is completed as illustrated partly by the cross-sectional view in FIG. 14. Further, the back light may be arranged outside of the display region and a light conductive plate may be used. Further, the cover and the liquid module are secured by adhesive or organic resin. In addition, since the active matrix liquid crystal display device is a transmissive type, a polarized plate 1303 is pasted onto both of the active matrix substrate and the opposing substrate. In addition, another optical film (an antireflection film, a polarized film, or the like) or a protective film (not shown) may be provided.

[0177]

Note that in FIG. 14, 1300 denotes a substrate; 1301, a pixel electrode; 1302, a columnar spacer; 1307, sealant; 1320, a color filter in which a colored layer and a light-shielding layer are arranged to correspond to each pixel; 1325, a planarized film; 1321, an opposing substrate; 1322, 1323, orientation films; 1324, a liquid crystal layer; and 1319, a protective film.

[0178]

In addition, this example can be freely combined with the best mode.

[Example 2]

[0179]

As a liquid crystal display device and an electric appliance according to the invention, a video camera, a digital camera, a goggles-type display (head mount display), a navigation system, a sound reproduction device (a car audio equipment, an audio set and the like), a notebook personal computer, a game machine, a portable information terminal (a mobile computer, a cellular phone, a portable game machine, an electronic book, or the like), an image reproduction device including a recording medium (more specifically, a device which reproduces a recording medium such as a digital versatile disc (DVD) and has a display for displaying the reproduced image), or the like can be given. In particular, it is desirable to apply the present invention to a large-sized TV or the like having a large screen. FIG. 19 shows specific examples of such electric appliances.

[0180]

FIG. 19 (A) illustrates a large display device having a large screen of 22 inches ~ 50 inches comprising a housing 2001, a support table 2002, a display portion 2003, a video input terminal 2005, and the like. Note that the display device includes all of the display devices for displaying information, such as a personal computer, a receiver of TV broadcasting, and bi-directional TV. According to the present invention, a comparatively low price large display device can be realized even if a glass substrate of generation five and the subsequent generation having a length of over 1000 mm on a side is used.

[0181]

FIG. 19 (B) illustrates a notebook personal computer comprising a main body 2201, a housing 2202, a display portion 2203, a key board 2204, an external connecting port 2205, a pointing mouse 2206, and the like. According to the present invention, a comparatively low price notebook personal computer can be realized.

[0182]

FIG. 19 (C) illustrates a portable image reproduction device including a recording medium (specifically, a DVD reproduction device) comprising a main body 2401, a housing 2402, a display portion A 2403, a display portion B 2404, a recording medium (DVD and the like) reading portion 2405, operation keys 2406, a speaker

portion 2407, and the like. The display portion A 2403 displays mainly image information, whereas the display portion B 2404 displays mainly text information. Note that the image reproduction device including a recording medium includes a domestic game machine and the like. According to the present invention, a comparatively low price image reproduction device can be realized.

[0183]

FIG. 19 (D) illustrates a TV having a wireless portable display. A housing 2602 is installed with a battery and a signal receiver, in which the battery drives a display portion 2604 and a speaker portion 2607. The battery has a charger 2600 capable of being charged repeatedly. In addition, the charger 2600 can send and receive image signals, and send the image signals to a signal receiver of the display. The housing 2602 is controlled by operation keys 2606. Also, the device illustrated in FIG. 19 (D) may be referred to as an image sound two-way communication device since signals can be sent from the housing 2602 to the charger 2600. Further, the TV can control communications of another electric appliance by sending a signal from the housing 2602 to the charger 2600 by operating the operation keys 2606 and by receiving signals that can be sent by the charger 2600 by another electric appliance. Accordingly, the TV may also be referred to as a versatile remote control device. According to the present invention, a comparatively large (22 inches ~ 50 inches) portable TV can be provided by low cost manufacturing processes.

[0184]

As mentioned above, a liquid crystal display device, which is obtained by practicing the present invention, can be used as a display portion of various kinds of electronic appliance.

[0185]

In addition, this example can be freely combined with any one of Embodiments 1 to 6, and Example 1.

[Industrial Applicability]

[0186]

According to the present invention, a patterning process can be shortened and an amount of materials used can be reduced in a manufacturing process for a liquid crystal display device for forming a conductive pattern. Therefore, the costs can be

drastically reduced regardless of the substrate size.

[Brief Description of the Drawings]

[0187]

[FIG. 1] Cross-sectional views for showing a manufacturing process of an AM-LCD.

[FIG. 2] Cross-sectional views for showing a manufacturing process of an AM-LCD.

[FIG. 3] A view for showing a top view of a pixel.

[FIG. 4] A view for showing a laser beam drawing device.

[FIG. 5] Views for showing a manufacturing process. (Embodiment 2)

[FIG. 6] Views for showing a manufacturing process. (Embodiment 3)

[FIG. 7] Views for showing a manufacturing process. (Embodiment 4)

[FIG. 8] A cross-sectional view of a channel stop TFT (Embodiment 5)

[FIG. 9] A cross-sectional view of a staggered TFT. (Embodiment 6)

[FIG. 10] A perspective view and cross-sectional views showing liquid crystal dropping performed by a droplet discharging method.

[FIG. 11] Views for showing top views of a process.

[FIG. 12] Cross-sectional view for showing a pasting device and a pasting process.

[FIG. 13] Top views of a liquid crystal module.

[FIG. 14] A cross-sectional structural view of an active matrix liquid crystal display device.

[FIG. 15] A block diagram for showing a driver circuit. (Example 1)

[FIG. 16] A circuit diagram for showing a driver circuit. (Example 1)

[FIG. 18] A perspective view for showing a droplet discharging device.

[FIG. 17] A circuit diagram for showing a driver circuit. (Example 1)

[FIG. 19] Views for showing examples of an electronic appliance.

[Explanation of Reference]

[0188]

10: substrate

11: base layer

12: conductive film pattern

15: gate electrode

[Name of Document] Drawings

[FIG. 1] (A) Dropping of material solution by droplet discharging method

11: base layer (TiOx)

(B) Selective laser irradiation

12: unexposed

(C) Developing

(D) Formation of semiconductor film

18: gate insulating film, 19: semiconductor film, 20: semiconductor film (n+), 21: mask

(E) Formation of SD wirings

Terminal portion, pixel portion

[FIG. 2] (A) Etching of semiconductor film

(B) Formation of protective film

(C) Formation of interlayer insulating film, connection electrode, and pixel electrode

(D) 39: liquid crystal, terminal portion, pixel portion

[FIG. 3] 30: pixel electrode, 15: gate wiring, 24: channel formation region

[FIG. 4] 401: laser beam direct drawing device

402: personal computer

403:laser oscillator

404: power source

405: optical system

406: acoustooptical modulator

407: optical system

408: substrate

409: substrate moving mechanism

410: D/A conversion portion

411: driver

412: driver

[FIG. 5] (A) Dropping

(B) Exposure to laser light

(C) Formation of SD wirings by developing

(D) Etching

terminal portion, pixel portion

[FIG. 6] (A) Dropping

(B) Exposure to laser light

(C) Formation of SD wirings by developing

(D) Etching

terminal portion, pixel portion

[FIG. 7] (A) Dropping

(B) Exposure of reverse surface to laser light

(C) Formation of SD wirings by developing

(D) Etching

[FIG. 8] terminal portion, pixel portion

[FIG. 9] terminal portion, pixel portion

[FIG. 10] (A) Discharging step

1116: droplet discharging device, 1114: liquid crystal material, 1118: nozzle, 1110: large substrate

(B) 1111: pixel portion, 1112: seal, 1114: liquid crystal material, 1110: large substrate, 1113: nozzle scanning direction, 1115: drop surface

(C) in the case of continuous discharging

Enlarged view of 1119

(D) in the case of discharging in dot

Enlarged view of 1119

[FIG. 11] (A) Formation of sealant, 1035: first substrate, 1032: sealant, 1034: pixel portion

(B) Liquid crystal dropping, 1033: liquid crystal

(C) Pasting of substrates, 1031: second substrate

(D) Cutting

[FIG. 12] (A) 1044: window (light-transmitting property), 1049: light source (ultraviolet light), 1031: second electrode, 1042: second substrate support medium, 1032: sealant, 1033: liquid crystal, 1035: first substrate, 1041: first substrate support medium, 1048: lower surface table (installed with heater)

(B) Light curing and thermal curing

1049: light source (ultraviolet light), 1048: lower surface table (installed with heater)

[FIG. 13] (A) 1201: substrate, 1205: FPC, 1204: pixel portion, 1206: opposing substrate, 1207: sealant

(B) 1211: substrate, 1215: FPC, 1212: source signal line driver circuit, 1213: gate signal line driver circuit, 1218: second sealant, 1216: opposing substrate, 1217: first sealant

[FIG. 14] 1306: cover, 1304: back light valve, 1307: sealant, 1303: polarized plate, 1320: CF, 1325: plananarized film, 1321: opposing electrode, 1322: orientation film, 1324: liquid crystal layer, 1323: orientation film, 1302: spacer, 1301: pixel electrode

TFT, storage capacitor, pixel portion

[FIG. 15]

[FIG. 16]

[FIG. 17]

[FIG. 18] 1507: stage

[FIG. 19] (A) 2003: display portion, 2001: housing, 2005: video input terminal, 2002: support table

(B) 2202: housing, 2203: display portion, 2201: main body, 2204: keyboard, 2205: external connecting port, 2206: pointing mouse

(C) 2403: display portion A, 2402: housing, 2401: main body, 2405: recording medium reading portion, 2404: display portion B, 2406: operation key, 2407: speaker portion

(D) 2602: housing, 2603: display portion, 2606: operation key, 2607: speaker portion, 2600: charger (capable of sending and receiving)

[Name of Document] Abstract

[Abstract]

[Object]

In the present circumstances, a film formation method of using a spin coating method is heavily used in a manufacturing process of a liquid crystal display device. As increasing the substrate size in future, the film formation method of using a spin coating method becomes a disadvantage in mass production since a mechanism for rotating a large substrate becomes large, and there are many loss of material solution and waste liquid.

[Solving Means]

According to the present invention, in a manufacturing process of a liquid crystal display device, a microscopic wiring pattern can be realized by discharging selectively photosensitive conductive material solution by a droplet discharging method, exposing selectively to laser light or the like, and developing. The present invention can reduce drastically costs since a patterning process can be shortened and an amount of material used in a process of forming a conductive pattern can be reduced. Accordingly, the present invention can be applied to a large substrate.

[Selected Drawing] FIG. 1